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With an AIMM for safer face masks

University of Dayton

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A reusable self-disinfecting N95 mask concept developed by a University of Dayton Research Institute scientist holds so much promise for success, the inventor has created a start-up company to commercialize the technology.

Using principles applied in his work as a battery scientist in UDRI's power and energy division, researcher Luis Estevez developed an anti-microbial technology that can be used to create a face mask that will not only filter viruses such as COVID-19 and other particles, but will kill those pathogens as well. The extra layer of defense makes the mask not only more protective, but reusable—providing a significant tool in response to the critical shortage of masks for health care providers.

With support from the University of Dayton's Office of Technology and Entrepreneurial Partnerships, Estevez established Advanced & Innovative Multifunctional Materials LLC (AIMM) in order to advance the technology and ultimately create working prototypes. Once prototypes are developed, certified by a medical device testing laboratory and receive regulatory approvals, Estevez hopes to partner with and license his mask to a medical equipment company for mass manufacture.

"N95 masks bear that name because they filter a minimum of 95 percent of airborne particles, including viruses and bacteria, from passing through the mask to the wearer. That means the wearer is at very low risk for infection from the few remaining particles," Estevez said. "While this type of mask is highly effective, there is a critical shortage of masks for healthcare workers—a shortage of hundreds of millions of masks in the U.S. alone, according to some reports. So providers are being forced to re-use them, but they are not designed to be re-used because of the risk of infection to themselves and others from handling masks that may have been contaminated by viruses and bacteria."

Some providers are taking steps, such as treating masks with steam or hydrogen peroxide, to mitigate that risk, but such treatments renders the mask much less effective, Estevez said. N95 masks are electrostatically charged during the manufacturing process, making them significantly more effective at blocking viruses and other particles from penetrating the mask, but that charge is disrupted if the mask becomes wet.

Estevez's solution involves adding a layer of biocidal silver nanomaterial to the exterior of the masks. Common in medical use for its antimicrobial properties, biocidal silver kills any microbial pathogens it comes in contact with. "Not only does this coating of nano-silver create an extra layer of protection from viruses and bacteria, but treated masks can be used repeatedly and for long periods of time without risk of contamination to the wearer or others."

There are some cloth masks currently available that include strands of silver and copper woven into the fabric, but they aren't as effective because the strands don't have enough surface area to be highly effective, many of the fibers are embedded below the surface of the mask, and because cloth masks are not as effective overall as the "gold standard" N95, Estevez said. What sets his technology apart is his "secret sauce"—a formula for controlling silver particle size, dispersal and adhesion to the surface of the mask.

Estevez has been working with Kenya Crosson, associate professor of civil and environmental engineering at UD, to perform proof-of-concept testing on mask material samples. "We still have some fine tuning to do, but we're excited about initial results," he said.

Estevez is also pursuing funding to advance the technology to prototype stage. Depending on funding, a prototype could be ready in as few as four months, he said.

"Once we have prototype masks in hand, we'll begin certification and regulatory approvals processes. Those are the steps needed to ensure the masks are breathable, safe and effective at stopping particles; in other words, that they will do what they are designed to do."

Estevez said he's eager to partner with a major manufacturer of medical supplies to bring a biocidal mask to the healthcare industry—whose providers will not only need access to safe masks for the near-term future, but will also need to stockpile masks for future events.

"The COVID-19 pandemic has highlighted a major problem within the healthcare industry, which is the inability to physically stockpile enough masks for emergencies such as this," he said. "It's not that hospitals weren't prepared for a health crisis, it's that COVID-19 hit so fast and so widespread that emergency stockpiles were depleted in a short time. Antimicrobial masks are a ‘next-gen' solution for future emergency stockpiles, because their extended reusability means fewer masks would be needed during a pandemic."

In addition to developing a mask, Estevez is laying the groundwork to retool the same biocidal technology to develop a portable, gravity-powered water purification system to be used in emergency disaster relief or other situations where there is an urgent need for safe drinking water. "Ultimately the goal would be to scale up the system to help provide purified drinking water in developing nations, where some 2 billion people have no access to local, non-contaminated water," he said.

When he's not in a lab, Estevez is also working to move his company forward. AIMM is now a client of the Entrepreneur Center in Dayton, which has already provided several useful resources, he said. In June and September, he won entrepreneurial "pitch" competitions held under the auspices of Launch Dayton, an informal collaboration of entrepreneurial resource providers across the region.

Mathew Willenbrink, director of technology partnerships at UD, said a provisional patent on the technology and a license agreement between the University and AIMM are pending. "Luis' technology shows a great deal of promise in addressing a critical need, and he has already shown his ability to be an outstanding entrepreneur," Willenbrink said. "We are happy to be able to support him in this endeavor."

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